

## **Designing an Online Class Using a Constructivist Approach**

Sang Chan

### **Abstract**

Students have more opportunities to take control of their learning in a constructivist classroom. Learning in this problem-based environment, the students can make sense and apply the learning in the daily life. Brooks and Brooks (1999) recommend five constructivist principles to help educators design a course that helps the students construct their own knowledge and find practicality of the learning. Designing and teaching a constructivist course can be challenging because it requires a great deal of time, effort, and interaction. The task becomes even more challenging for an online class because of the absence of the face-to-face meetings. Therefore, this study discusses approaches that can be used to design an online class based on the constructivist principles. Research indicates that a course design based on constructivism is essential to the success of online learning.

### **Introduction**

Constructivism is known to have multiple roots in philosophy and psychology (Perkins, 1991 as cited in Driscoll, 2005) and also in sociology and anthropology (Jonassen, Cernusca, & Ionas, 2007). Some researchers consider constructivism to be a learning theory (Staitis & Wilke, 2007, etc.). However, others argue that it is an epistemology (Driscoll, 2007; Jonassen, Cernusca, & Ionas, 2007) and is a learning principle or philosophy because it does not have sufficient explanatory power to be considered a learning theory (Smith & Ragan, 2004). Jonassen et al. (2007) state that “constructivism is a philosophy that underlies theories from which pedagogies and models are derived” (p. 46).

---

Sang Chan is a Doctoral Candidate in Instructional Design, College of Education, Idaho State University.

Although there are different views on what constructivism is, there is a common agreement that constructivism has played an important role in learning and instruction. According to Reiser (2007), constructivist views of teaching and learning have had a major influence on thoughts and actions of both practitioners and theorists in the field of instructional design. Constructivist views have had influence on learning conditions and instructional strategies (Driscoll, 2007) and on instructional activities and “the epistemological and ontological assumptions about the nature of learning” (Jonassen, Cernusca, & Ionas, 2007, p. 46). Jonassen et al. (2007) further state that, because of the emergence of constructivism, the instructional systems field has been shifted from instructional communication to practice-based learning.

### **Constructivism**

Constructivism is often viewed in comparison with objectivism (traditional teaching). According to the epistemological assumptions of objectivism, knowledge is obtained from individual experience. As the experience grows broader, the knowledge also expands wider and deeper (Driscoll, 2005). Objectivist principle assumes that knowledge exists independently of learners, and learning is about transferring knowledge from an outside source to the learners. On the other hand, constructivists believe that the knowledge is constructed by the individual learners and “is embodied in human experience, perceptions, imaginations, and mental and social constructions” (Jonassen, Cernusca, & Ionas, 2007, p. 46). And to construct knowledge, learners need to solve problems, to be active, and to take actions to accomplish goals (Dijkstra, 1997).

The learners make sense of the world by connecting prior experience to the new information (Staitis & Wilke, 2007). The new and conflicting experiences will derange learners’ existing structure which must be modified to make sense of the new information (Driscoll, 2005). Jean Piaget coined the term “accommodation” to describe this process (Wadsworth, 1988, pp.14-15). According to Driscoll (2005, 2007), constructivists argue strongly that knowledge can be constructed without any correspondence to external reality to be meaningful. Learning should be embedded in authentic contexts.

Based on previous studies, the influence of constructivism in instruction and learning has been widely recognized. Many educators have adopted and applied the constructivist approach in classroom

settings, believing that constructivism could make learning meaningful, practical, and authentic in promoting high learning transfer of the learners (Driscoll, 2005, 2007; Jonassen, Cernusca, & Ionas, 2007). To assist educators in creating a constructivist-based learning environment, Brooks and Brooks (1999) recommend five guiding principles of constructivism to provide the learners with valuable learning experience. These principles include:

(1) *Posing problems of emerging relevance to students*: Students who come to the classroom are not all interested in learning. Learning needs to be relevant to the learners in some way or another. Ausubel's meaningful learning theory states that meaningful learning is the process of relating potentially meaningful information to prior knowledge in a non-arbitrary and substantive way (Driscoll, 2005). Therefore, relevancy to what is already known is the key for the learners to construct and understand the learning concepts. Brooks and Brooks (1999) suggest that "[p]roblems with little or no initial relevance to students can be made relevant through teacher mediation before or after the problem is posed" (p. 36). Teacher mediation includes posing problems for students to solve, experimenting on learning issues, offering immediate feedback, challenging learners' original assumptions by using questioning strategies to spark their interest, and providing them with opportunities to contribute. However, Brooks and Brooks (1999) note that "relevance does not have to be pre-existing for the student" (p. 35).

(2) *Structuring learning around primary concepts*: Learners are most engaged when the information is presented in a holistic manner instead of in isolated parts (Brooks & Brooks, 1999). Many learners are not able to build concepts from parts to whole. Therefore, they need to see the whole before they can make sense of the parts. When learning is clustered around broad concepts, the learners can choose their unique problem-solving techniques and apply them to construct new understanding of the learning. "Learners at all ages are more engaged by concepts introduced by the teacher and constructed by the learners from whole-to-part, rather than part-to-whole" (Brooks & Brooks, 1999, p. 49). Structuring learning around "broad concepts provides multiple entry points for students" to become engaged through practical responses, to analyze model-based or principle-based tasks, or to interpret ideas through analogies or metaphors (p. 58). Gestalt psychologists support the idea that complex information will lose its meaning when broken down into parts (Schunk, 2008). They state that what is meaningful is the

configuration, not the individual parts. The sum of parts is not equal to the whole. Along with it, Van Merriënboer (2007) proposed the Four Component Instructional Design Model (4C/ID) to holistically design the instruction without breaking it into small elements (fragmentation). The four components include learning tasks, supportive information, procedural information, and part-task practice.

(3) *Seeking and valuing students' points of view*: Understanding learners' points of view is to understand their reasoning (Brooks & Brooks, 1999). Awareness of their views assists educators in challenging them and making the learning experience both contextual and meaningful. Instead, educators who are not aware of their learners' points of view "often doom students to dull, irrelevant experiences, and even failure" (p. 60). Valuing learners' opinions means both recognizing them and addressing them. It is the educator's willingness to ask questions and listen to the learners. Educators should also provide the learners with opportunities to express their opinions and to reveal and reflect upon their conceptions. However, it is cautioned that both challenging and seeking for elaboration could threaten students. Therefore, the educator needs to inform the learners that the educator is truly interested in knowing more about what they think and why, so the learners can overcome the fear and aversion of the practices.

(4) *Adapting curriculum to address students' suppositions*: "Learning is enhanced when the curriculum's cognitive, social, and emotional demands are accessible to the student" (Brooks & Brooks, 1999, p. 69). Adapting curriculum or instruction to learners' suppositions can be accomplished by teacher mediation. Constructivist educators need to take learners' cognitive development, assumptions, and social context into account when designing instruction to address their suppositions. It is important that educators not impose their expectations on a learner's thought process. Educators can help their learners build new, complex knowledge by providing them with opportunities to use their own reflective abstractions to create new understanding. If learners' suppositions are not clearly addressed, their learning is deprived of meaning, regardless of how charismatic the educators are or attractive the learning materials might be. Piaget's cognitive development theory supports this principle. According to Piaget, instruction should fit learners' cognitive development for learning to occur (Wadsworth, 1988). In other words, development sets the stage for learning. Although different learners have different cognitive structure and pre-existing

assumptions and beliefs, Brooks and Brooks (1999) do not recommend a “one-to-one match between the cognitive demands of curricular tasks and student’s cognitive abilities” because it “can result in the failure of schools” (p. 69).

(5) *Assessing student learning in the context of teaching*: Educators should not assess students based on a “right” or “wrong” response because such an assessment hurts them and makes them feel foolish and invalidated (Brooks & Brooks, 1999). Moreover, this assessment method conveys a message to the learners that their different thinking is not valued by the educator. As a result, it erodes learners’ desires to think creatively and to explore the learning problems intensively. Rather than assessing right or wrong, the educator assesses learners’ progress to see if they need more help and resources to complete the task. Educators should also provide non-judgmental feedback to the learners for further improvement. Assessment should be context-based and authentic. Teaching the learners to construct their own knowledge and then testing them in a traditional test-oriented mode communicates a confusing message to the student. “Assessing through teaching, through participating in student/teacher interactions, through observing student/student interactions, and through watching students work with ideas and materials tells us more about student learning than tests and externally developed assessment tasks” (p. 97).

### **Online Learning**

It is widely known that the 21<sup>st</sup> century is the period of technology advances (Inglis, 2007). The internet has played an increasingly important role in the teaching and learning environment (Buzzetto-More, 2007). The increasing demand to incorporate new technologies in teaching challenges both faculty and the entire institutional systems (Salter, Richards, & Carey, 2004) and presents both exciting and frightening opportunities for educators (Inglis, 2007).

According to Allen and Seaman (2007), approximately 3.48 million students took at least one online class in fall 2006, which was equal to almost 26 percent of all US higher education students. The growth rate of online enrollment was 9.7 percent, which is higher than the growth rate of the overall higher education student population registered at 1.5 percent. Moreover, among all higher education institutions, two-thirds had some form of online learning. And 83 percent of all institutions

offering online courses expected the online enrollments to increase in the coming year. Therefore, it is believed that online learning will become a trend in future education. As a result, educators should be well prepared for this future change. Given the fact about online learning, one question can be asked: How can educators design an online class that facilitates effective learning of the students?

### **Constructivism and Online Learning Design**

Researchers suggest that a course design which is based on constructivism is essential to the success of online learning (Rossner-Merrill, Parker, Mamchur, & Chu, 1998; Salter, Richards, & Carey; 2004; etc.). Constructivism and the infusion of technology offer real promise for the improvement in the achievement of the subject matter (Lunenburg, 1998). Lunenburg and Ornstein (1996) argue that constructivism and technology might be the key to the educational reform (cited in Lunenburg, 1998).

According to Gazi (2009), the constructivist approach encourages students to manage their learning through “meta-cognitive, self-reflective and collaborative process” (p. 69). Furthermore, Gazi found that a constructivist-based online course improved students’ learning and enhanced “communication, teamwork, critical thinking, [and] self-responsibility skills” (p. 74). Gazi further states that the constructivist course provides learners with in-depth knowledge and experience in subject area, enhances deep and active learning, and develops higher order thinking, research skills, reflection, collaboration, presentation skills, and problem-solving skills. The learners also develop more positive attitudes in a constructivist learning environment than in a traditional classroom. Rossner-Merrill, Parker, Mamchur, and Chu (1998) found that an online course that was based on constructivist principles constantly improved and expanded the development of students’ writing skills

A 2004 edition of the E-learning Guild’s online journal states that “Technology, especially computer technology and the Web, offers many resources that have proven successful over the last two decades as supplements to constructivist practices in the classroom, in adult education, and in distance learning” (as cited in Bellefeuille, Martin, & Buck, 2005). And Bellefeuille et al. (2005) also argue that the computer-

based instructional design and web-based instruction offer learning environments that are “more inherently constructivist in nature” (p. 374).

Given the fact that “[r]ecently, much interest is evidenced in the potential for constructivist theory to inform the design of courses taught in classrooms and in hypermedia learning environment” (Rossner-Merrill, Parker, Mamchur, & Chu, 1998, p. 282), this study suggests five ways to design an online course based on the five principles of constructivism recommended by Brooks and Brooks (1999), as follows.

(1) *To pose problems of emerging relevance to students*, the instructor should engage the learners in the problem-solving learning process. The instructor can introduce case studies that reflect real life problems to the learners. To use the case study method, the learners and the instructor will first report, analyze, and discuss the case (Marsick, 2004). The instructor can also choose to develop cases to use in the classroom (consult Alden & Kirkhorn, 1996; Marsick, 2004 for further details on case studies). Besides case studies, the instructor can also use the case story technique (Maslin-Ostrowski & Ackerman, 2004). The case story provides the learners with opportunities to learn from and reflect on their own experience and to build on other’s experiences. With case story, the learners choose an experience from the past or present and write about that experience. The learners then tell the story to the class and the class discusses the story. The class can ask the storyteller only to clarify the issues, not to try to help the storyteller to solve his/her individual life dilemma.

To implement these activities online, the instructor can create synchronous and asynchronous online activities (Guy, 2007). For the case study method, the instructor can use a discussion board, video, or audio (Girard, Willoughby, & Berg, 2007) to introduce the case to the learners. The learners then analyze and discuss the case on the discussion board. Online video conferencing, chat room, or other synchronous means can be used in case discussion to allow real-time interaction to take place. The instructor can also form virtual teams (Girard, Willoughby, & Berg, 2007) by using a group tool on the Learning Management System for this activity if necessary. For the case story method, the similar means can be used. Instant messaging can be made available to the class to ask and answer questions. Forums, blogs, or wikis can be used to post their personal stories for class discussion and reflection.

(2) *Rather than presenting information to the students, the instructor structures the learning around the primary concept*, which allows the students to explore a subject matter by themselves. Teaching in a holistic manner engages the learners and can prevent them from losing sight of the whole idea. The instructor can introduce a topic and let the learners engage in a self-initiated inquiry to learn about the topic. For example, if the instructor would like to teach the students about World War I and World War II, rather than presenting the information, the instructor can ask them to compare and contrast the two wars, with elements such as number of countries involved, causes of wars, consequences of wars, and lessons learned from the wars. This way of teaching allows the students to get in touch with the primary concepts and holistic ideas instead of the parts and pieces of the information.

Van Merriënboer (2007) warned the educators about the danger from breaking the concepts into parts (part-task approach). He cautioned that this approach made it difficult to integrate new information into prior knowledge and to employ it to solve new problems. Van Merriënboer developed the 4C/ID model to holistically design instruction to improve the learning transfer. To teach complex tasks in a holistic manner, the instructor first introduces the learners to a relatively simple version of the task and progresses toward a more difficult task. Learning guidance and supports should be provided to the learners to help overcome the complexity of learning. The instructor will withdraw those supports gradually when the learners acquire more expertise (scaffolding). The instructor needs to teach learners the prerequisite skills and knowledge (Van Merriënboer, 2007), fundamental structure (Bruner, 1977), and conceptual themes (Bybee, 1989 in Brooks & Brooks, 1999) to make later, complex learning easier.

To design an online class based on this principle, the instructor can use videos, animations, or audios to arouse learners' interest and to introduce a learning topic. The learners then learn more about the topic by going to a variety of websites and sources provided by the instructor. The learners select and analyze the information and exchange their views on the discussion board. Chat room or internet conferencing should be used to make real-time conversation possible for immediate answers and questions. The instructor can provide support and guidance via emails, instant messaging, or discussion board to the learners.

(3) *To seek and value students' views*, the instructor should ask for elaboration on learning issues to understand learners' reasoning. The



discussion board, email, web-chat, or video conference can be used to achieve the goal. The instructor can use questioning strategies (Miller & Miller, 2002) to keep the discussions going, to encourage reflection, and elicit elaboration. It is important for learners to know that their opinions be valued, regardless of who they are and where they are from.

Individual projects can be used to learn about the learners' interests. The learners select a learning topic for their project from a variety of learning choices that are relevant to the learning issue. The instructor can ask them to upload their work (e.g., in MS Word, PDF, video, or audio format) online to share with others and for discussion. The instructor will provide immediate feedback to the learners for improvement.

Class discussion is usually a good way to elicit students' responses on learning problems "because of its democratic associations" (Brookfield, 2004, p. 209). This activity can be implemented on a discussion board, a chat room, blogs, wikis, and/or video conferencing.

Asking the class to solve learning problems in an online class is also another way to seek the students' points of view and reasoning. Problem-solving methods encourage the learners to share and discuss the problems without being afraid of being assessed based on either "yes" or "no." Brooks and Brooks (1999) warn educators regarding assessment based on a right or wrong answer:

Students try to "steal" others' points of view because schools have somehow subordinated the formation of concepts and the building of ideas to high-stakes games of "right" and "wrong" answers that produce winners and losers. The system itself gives students the message that it's better to be "right" than to have interesting ideas. Faced with this sort of pressure, many students—97 percent by their own acknowledgement, more than most people in our community expected—choose to copy. (pp. 67-68)

(4) *To adapt curriculum to address student's suppositions* in an online class, the instructor needs to learn about the learners by conducting a learner analysis (Shambaugh & Magliaro, 1997) and by individualizing instruction to suit individual learners. The instructor should take learners' assumptions, social context, and thinking into account. The instructor should provide additional help to those who need guidance by directing them to different web sites or other resources so they can conduct further research on certain learning problems. Feedback should be offered in a timely manner in order to help the learners move

forward during the learning process. Individual projects (as described earlier) can be useful to learn about students' thinking, reasoning, and personal interests. The instructor also needs to challenge learners' assumptions to help them further develop by exposing them to different contrasting ideas to help them reflect on their current thoughts and beliefs.

Assigning learners to work in a group formation and providing them with problems to solve provokes their thoughts and helps them reflect because social interactions, as Piaget believes, are a key to development and reflection (Wadsworth, 1988). Among online learning activities, the game-playing technique, e.g., *Ask Sensei* (Wanless-Sobel, 2007), helps the instructor accomplish this goal. This game requires the Senseis (assigned team) to reflect on their thoughts and think critically in order to help solve other learners' problems. In the game, the instructor requests the students, except the Senseis, to post anonymous real-life problems on the discussion board. The students need to wait for the Senseis to respond to their questions. The students are required to return to check the discussion board to see the responses and to engage in conversation. All students have an opportunity to play a role as a Sensei, and the Sensei identity is not revealed to the class during the game (consult Wanless-Sobel, 2007 for detailed information). This activity helps the Senseis reflect on their thoughts and search for more information to be able to assist other students in answering their questions or solving their problems.

(5) *To assess student learning in the context of teaching in an online environment*, the instructor assesses learners' performances based on, for example, the quality of online discussions, synchronously and asynchronously with other students and the instructor, rather than assessing based on multiple choice questions or standardized tests on the basis of either wrong or right answers (Brooks & Brooks, 1999). The instructor needs to provide non-judgmental feedback to the learners for improvement in separate emails or via the grading tool.

The instructor can assess the learners' performances based on the context and authentic tasks. Referring back to the *Ask Sensei* game (Wanless-Sobel, 2007), the instructor can assess the Sensei group based on their responses to other learners' questions, instead of giving them a right or wrong feedback. The instructor can provide necessary supports and assistance to the *Sensei* group during this learning process, when necessary. In conclusion, the instructor can use criteria such as the

dynamic of group discussion and interaction, allocation of group responsibilities, and response quality as the basis for the assessment.

### **Conclusion**

To be a constructivist teacher, one needs to allow students to take control over their learning. Constructivist classrooms provide learners with opportunities to plan and direct their learning. The learners construct their own knowledge and the instructor creates a conducive environment in which he/she plays a supporting role. Brooks and Brooks (1999) recommend twelve ways to become a constructivist teacher: (1) encourage and accept student autonomy and initiative; (2) use raw data and primary sources along with manipulative, interactive, and physical materials; (3) frame tasks by using cognitive terminology such as classify, analyze, predict, and create; (4) allow student responses to drive lessons, shift instructional strategies, and alter content; (5) inquire about students' understandings of concepts before sharing their own understanding of those concepts; (6) encourage students to engage in dialogue, both with the teacher and with one another; (7) encourage student inquiry by asking thoughtful and open-ended questions and by encouraging students to ask questions of each other; (8) seek elaboration of students' initial responses; (9) engage students in experiences that might engender contradictions to their initial hypotheses and then encourage discussion; (10) allow wait time after posing questions; (11) provide time for students to construct relationships and create metaphors; and (12) nurture students' natural curiosity through frequent use of the learning cycle model.

In the 21st century, the internet plays a crucial role in education. Studies suggest that constructivism is essential to the success of online learning. Educators should adapt to the change and consider applying the technology along with the constructivist principles to create an environment that facilitates learning to help the students learn more effectively, enjoy their learning, and be successful in their education. Isn't it the goal of the instruction? Isn't it what a constructivist teacher really wants to accomplish?

## References

- Alden, J., & Kirkhorn, J. (1996). Case studies. In R. L. Craig (Ed.), *The ASTD training and development handbook: A guide to human resource development* (4th ed., pp. 497-516). New York: McGraw-Hill.
- Allen, E., & Seaman, J. (2007). *Online nation: Five years of growth in online learning*. Needham, MA: Sloan Consortium.
- Bellefeuille, G., Martin, R. R., Buck, M. P. (2005). From pedagogy to technagogy in social work education: A constructivist approach to instructional design in an online, competency-based child welfare practice course. *Child and Youth Care Forum*, 34(5), 371-389.
- Brookfield, S. D. (2004). Discussion. In M. W. Galbraith (Ed.), *Adult learning methods: A guide for effective instruction* (3rd ed., pp. 209-226). Malabar, FL: Krieger Publishing.
- Brooks, J. G., & Brooks, M. G. (1999). *In search of understanding: The case for constructivist classrooms*. Danvers, MA: Association for Supervision and Curriculum Development.
- Bruner, J. S. (1977). *The process of education*. Massachusetts: Harvard University Press.
- Buzzetto-More, N. A. (Ed.). (2007). *Principles of effective online teaching*. Santa Rosa, CA: Informing Science Press.
- Dijkstra, S. (1997). The integration of instructional systems design models and constructivist design principles. *Instructional Science*, 25(1), 1-13.
- Driscoll, M. P. (2005). *Psychology of learning for instruction* (3rd ed.). Boston, MA: Allyn and Bacon.
- Driscoll, M. P. (2007). Psychological foundations of instructional design. In R. A. Reiser & J. V. Dempsey (Eds.), *Trends and issues in instructional design and technology* (pp. 36-44). Upper Saddle River, NJ: Pearson Education.
- Gazi, Z. A. (2009). Implementing constructivist approach into online course designs in distance education institute at Eastern Mediterranean University. *Turkish Online Journal of Educational Technology*, 8(2), 68-81.
- Girard, J., Willoughby, L., & Berg, K. (2007). Video, voice, and virtual collaboration: The 3V's of asynchronous education. In N. A. Buzzetto-More (Ed.), *Principles of effective online teaching* (pp. 39-54). Santa Rosa, CA: Informing Science Press.

- Guy, R. (2007). The role of interaction in e-learning. In N. A. Buzzetto-More (Ed.), *Principles of effective online teaching* (pp. 83-103). Santa Rosa, CA: Informing Science Press.
- Inglis, J. (2007). Video conferencing the classroom: A glimpse at the use of this technology in education. In N. A. Buzzetto-More (Ed.), *Principles of effective online teaching* (pp. 155-177). Santa Rosa, CA: Informing Science Press.
- Jonassen, D., Cernusca, D., & Ionas, G. (2007). Constructivism and instructional design: The emergence of the learning sciences and design research. In R. A. Reiser & J. V. Dempsey (Eds.), *Trends and issues in instructional design and technology* (pp. 45-52). Upper Saddle River, NJ: Pearson Education.
- Lunenberg, F. C. (1998). Constructivism and technology: Instructional design for successful education reform. *Journal of Instructional Psychology*, 25(2), 75-81.
- Marsick, V. J. (2004). Case study. In M. W. Galbraith (Ed.), *Adult learning methods: A guide for effective instruction* (3rd ed., pp. 383-404). Malabar, FL: Krieger Publishing.
- Maslin-Ostrowski, P., & Ackerman, R. H. (2004). Case story. In M. W. Galbraith (Ed.), *Adult learning methods: A guide for effective instruction* (3rd ed., pp. 193-207). Malabar, FL: Krieger Publishing.
- Miller, W. R., & Miller, M. F. (2002). *Instructors and their jobs* (3rd ed.). Homewood, IL: American Technical Publishers.
- Reiser, R. A. (2007). A history of instructional design and technology. In R. A. Reiser & J. V. Dempsey (Eds.), *Trends and issues in instructional design and technology* (pp. 17-34). Upper Saddle River, NJ: Pearson Education.
- Rossner-Merrill, V., Parker, D., Mamchur, C., & Chu, S. (1998). Using constructivist instructional design featured in two online courses: Notes from the field. *Educational Media International*, 35(4), 282-288.
- Salter, D., Richards, L., & Carey, T. (2004). The 'T5' design model: An instructional model and learning environment to support the integration of online and campus-based courses. *Educational Media International*, 41(3), 207-217.
- Schunk, D. H. (2008). *Learning theories: An educational perspective* (5th ed.). Upper Saddle River, New Jersey: Pearson Prentice Hall.

- Shambaugh, R. N., & Magliaro, S. G. (1997). *Mastering the possibilities: A process approach to instructional design*. Needham Heights, MA: Allyn and Bacon.
- Smith, P. L., Ragan, T. J. (2004). *Instructional design* (3rd ed.). Hoboken, New Jersey: John Wiley and Sons.
- Straits, W., & Wilke, R. (2007). How constructivist are we? Representations of transmission and participatory models of instruction in the Journal of College Science Teaching. *Journal of College Science Teaching*, 36(7), 58-61.
- Van Merriënboer, J. J. G. (2007). Alternate models of instructional design: Holistic design approaches and complex learning. In R. A. Reiser & J. V. Dempsey (Eds.), *Trends and issues in instructional design and technology* (pp. 72-81). Upper Saddle River, NJ: Pearson Education.
- Wadsworth, B. J. (1988). *Piaget's theory of cognitive and affective development* (4th ed.). New York: Longman.
- Wanless-Sobel, C. (2007). Using games to increase problem solving skills: The theory, design, and implementation of an effective game unit. . In N. A. Buzzetto-More (Ed.), *Principles of effective online teaching* (pp. 291-324). Santa Rosa, CA: Informing Science Press.